

MAJOR-GENERAL SIR ANDREW SCOTT
WAUGH

FROM a paper in the *Royal Engineer Journal*, we obtain some interesting facts concerning the career of this able officer of the Indian Survey, whose death we announced at the time (vol. xvii. p. 350). Having been appointed in July, 1832, and retiring in 1861, his services in the department extended over a period of close upon thirty years.

Under Col. Everest, as his astronomical assistant, Waugh took part in the measurement of the great arc of the meridian extending from Cape Comorin, the most southern point of the peninsula of India, to the Deyrah Doon at the base of the Himalayas. In December, 1834, we find him with his Chief at the measurement of the northern base-line in the above valley, an operation that extended over a year. In the connection of this base with that near Sironj, about 450 miles to the south, Waugh took a large share of work, and also, in 1837, at the re-measurement of this Sironj base with the new bars that had been used in the Deyrah Doon. The wonderful accuracy secured on these grand operations may be estimated by the difference of length of the Deyrah base-line, as measured, and as deduced by triangulation from Sironj, being only 7·2 inches.

He shared with Everest the arduous observatory work, carried on simultaneously at the stations of Kaliana, Kalianpur, and Dumargidda, by which the arc of amplitude was determined, and brought this important work to an end in 1841. Between 1834 and 1840 he was also conducting the Ranghri series in the North-West Provinces, and in 1842, the triangulation through the malarious Rohilkund Terai, which Everest acknowledged to be "as complete a specimen of rapidity combined with accuracy of execution as there is on record." Sir Andrew thus had the good fortune to be the immediate pupil of the great geodesist who placed the Indian Surveys on their present footing, for the whole system was then elaborated and brought to a high pitch of excellency. This, Waugh, on succeeding to the appointment of Surveyor-General and Superintendent of the Topographical Survey in 1843, made it his first object to keep up and improve. Sir George Everest's high opinion of the man who had served under him on so many important operations may be understood from the singularly strong terms which he used when recommending Waugh as his successor.

He began by carrying out the remaining series, seven in number, a total of 1,300 miles in length and embracing an area of some 28,000 square miles, originating from the Calcutta longitudinal series on the *gridiron system* projected by Sir G. Everest. The eastern side was formed by the Calcutta meridional series (begun in 1844 and finished in 1848), which terminated in another base-line near the foot of the Darjeeling hills.

One of the finest of surveying operations, commenced about this period of Sir A. Waugh's tenure of office, was the north-east Himalaya series, connecting the northern ends of all the before-mentioned meridional series. In these field-operations Waugh took a leading part. The line of country was along the base of the Himalayas (the Terai). These operations led to fixing the positions and the heights of some of the highest and grandest of the Himalayan peaks in Nipal and Sikkim; one of these, 29,002 feet above the sea, was named by Waugh Mount Everest, and was found to be the highest in the world; its name, one well-known to the natives, is Dévidanga. Mr. Clements Markham, in his exhaustive memoir on the Indian Surveys, states that the dangers and difficulties in the execution of this work were far greater than have been encountered in the majority of the Indian campaigns.

On the South of India, the South Concan, the Madras

coast series, the South Parisnath and South Maluncha series were also begun and finished, and several pages might be written of the dangers and difficulties the Survey Staff had to contend with. Of all the Indian Survey-work that originated in Col. Waugh's tenure of office, on account of the general interest attaching to the country, its beauty, and its vastness, the survey of Kashmir was chief. This important and difficult survey, finally completed in 1864, was in full swing of work at the time Sir Andrew Waugh retired from the department, and we cannot do better than quote the lines the late Lord Canning was pleased to write privately to Sir Andrew Waugh in July, 1859, on being shown the first instalment of this work. Coming from so high and intelligent a source, they are a tribute not only to the Surveyor-General, but to the whole department. "I cannot resist telling you at once with how much satisfaction I have seen these papers. It is a real pleasure to turn from the troubles and anxieties with which India is still beset, and to find that a gigantic work of permanent peaceful usefulness, and one which will assuredly take the highest rank as a work of scientific labour and skill, has been steadily and rapidly progressing through all the turmoil of the last two years. I never saw a more perfect or artistic-like production of its kind than this map."

The other meridional series were also pushing forward. Jogi Tila by Jhelum and the Gurhagurh by Umritsur to join the Arumlia. Kattywar and Cutch must also be included. For a full and detailed account of these many difficult operations that comprise every kind of country and climate that India presents, we must refer the reader to the memoir before-mentioned.

Space will not allow us to enter into detail of all the important work done for the survey of India during Waugh's tenure of office, but it may be stated roundly that he advanced the triangulation by no less than 316,000 square miles, an area three times that of England, Wales, Scotland, and Ireland, and of this 94,000 were topographically surveyed. Col. Waugh retired from the service in 1861, receiving as usual the honorary rank of Major-General, and Her Majesty conferred on him the honour of knighthood in the same year. He had held the post of Surveyor-General for seventeen years, had maintained the high character of the survey, and was highly esteemed by the whole department. The results of the work during his incumbency are given in some thirteen different volumes and reports deposited in the India Office, parts of which originally complete appear to have been lost. In 1856 the Royal Geographical Society presented him with their gold medal, and in 1858 he was elected a member of the Royal Society. For some years past his health had been failing, and he suffered much, dying on February 21, 1877, at his residence in South Kensington.

THE HARVEY TERCENTENARY

ON Saturday evening the Royal College of Physicians commemorated the tercentenary of Harvey, the discoverer of the circulation of the blood, by a banquet in the library of their institution in Pall Mall. The president, Dr. Risdon Bennett, occupied the chair, and the company included the Marquis of Ripon, Viscount Cardwell, Mr. Gladstone, M.P., Mr. Lowe, M.P., Mr. Spencer Walpole, M.P., Baron Cleasby, Mr. Justice Denman, Prof. Huxley, Dr. Allen Thomson, Prof. Owen, Capt. Cameron, R.N., Dr. Carpenter, Mr. Benett-Stanford, M.P., Dr. Lyon Playfair, M.P., the President of the Royal College of Surgeons, the President of the College of Physicians, Ireland, Dr. Richardson, Sir W. Jenner, and Sir W. Gull.

The Marquis of Ripon and Mr. Walpole, M.P., in responding to the toasts of the House of Lords and the House of Commons, respectively, paid high tributes

to the memory of Harvey and to the reputation of the College of Physicians, while Lord Cardwell spoke with much satisfaction of the legislation resulting from the investigations of the Commission on Vivisection. The speech of the evening, however, was undoubtedly that of Prof. Huxley, in responding to the toast of the evening, "The Memory of Harvey," proposed in happy terms by the President. Prof. Huxley replied as follows:—

Mr. President,—In attempting to fulfil the task you have imposed upon me, I am mindful that I address myself to an audience which is already familiar with William Harvey's claims to the honour which we are assembled to show him. For, within these walls, the memory of your illustrious Fellow and chief benefactor, is kept perennially green by the customary piety of the speaker of the annual oration which Harvey founded; and his merits have been placed before you, with exhaustive completeness, by a long succession of able and eloquent orators. Even if the time and place were fitted for a disquisition on these topics, I could not hope to be able to add to the facts already known, or to place them before you in a new light. And, happily, this is not my function; I have to act simply as your remembrancer, to play the part of the herald who announces the familiar titles of a monarch on a state occasion.

Harvey's titles are three—he was the discoverer of the circulation of the blood; he wrote the "*Exercitatio de Motu Cordis et Sanguinis*"; he formulated anew the theory of epigenesis, and thereby founded the modern doctrine of development.

His first and, in general estimation, his greatest title to our honour has been challenged; but only to the confusion of the challengers. A century ago, your Fellow, Dr. Lawrence, in the excellent memoir prefaced to the College edition of Harvey's works, met the arguments of those who had, up to that time, attempted to dim his fame, with a solid refutation, which has never been answered and to my mind remains unanswerable. In our own day, Dr. Willis has stated the facts of the case, and deduced the inevitable conclusion, with no less force and cogency. And, having taken some pains to get at the truth of the matter myself, I may state my clear conviction that Harvey stands almost alone among great scientific discoverers, not so much that, as Hobbes said, he lived to see the doctrine he propounded received into the body of universally accepted truth, but because that doctrine was both absolutely original, and absolutely new. I have yet to meet with a single particle of evidence to show that, before Harvey declared the fact that the blood is in constant circular motion, there was so much as a suspicion on the part of any of his predecessors or contemporaries that such is the case. Neither in Galen, nor in Servetus, nor in Realduus Columbus, nor in Cæsalpinus, is there a hint that a given portion of blood sent out from the left ventricle, passes through the body and the lungs, and returns to the place from whence it started; yet this is the essence of Harvey's discovery.

Hence when we hear of pompous inscriptions being put up in Spain to Michael Servetus, "the discoverer of the circulation," or in Italy to Cæsalpinus "the discoverer of the circulation;" it is well to recollect that churchyards have no monopoly of unhistorical inscriptions. Indeed, have we not ourselves, within easy walking distance, that famous monument, the subject of Pope's scathing but just lines—

"And London's column, soaring to the skies
Like a tall bully, lifts its head and lies."

Sir, I have no sympathy with Chauvinism of any kind, but, surely, of all kinds that is the worst which obtrudes pitiful national jealousies and rivalries into the realm of science. We will not shame ourselves by permitting the fact of Harvey's English birth to enter into the consideration of his claims as a discoverer; but those claims once established beyond dispute, it is, I hope, something

nobler and better than mere national vanity which brings us together to celebrate his birth; to take an honest pride that such a man came of our English race; and as, I hope, to feel the deep responsibility which is laid upon us to have a care that the stock which in the same hundred years bourgeoned out in a Harvey and a Newton, shall not have its capacity for producing like growths in the present and in the future, starved by devotion to mere material interests, or stunted by ignorant outcries against scientific investigation.

The second title which I have claimed for Harvey is that of author of the "*Exercitatio de Motu Cordis et Sanguinis*." And that title is, happily, quite indisputable. But some may suppose that I have so far thrown myself into the spirit of my assumed office as to insert a superfluous appellation—a sort of "Defender of the Faith." However, this would be an error. Harvey might have discovered the circular course of the blood; he might have given sufficient evidence of his discovery; and yet he might have been quite incapable of writing that little essay of fifty pages which no physiologist of the present day can read without wonder and delight. For, not only is it a typical example of sound scientific method and of concise and clear statement; but, in addition to the evidence of the course of the blood through the body, it contains the first accurate analysis of the motions of the heart; the first clear conception of the mechanism of that organ as a pumping apparatus; the first application of quantitative considerations to a physiological problem; and the first deductive explanation of the phenomena of the pulse and of the uses of the valves of the veins. "*Libellus aureus*," Haller called it—and never was epithet more aptly bestowed.

Harvey's third title to honour is the authorship of the "*Exercitationes de Generatione*." In this treatise Harvey grapples with two of the most difficult problems of biology—the physiological problem of generation and the morphological problem of development. It was simply impossible that he should solve these problems, for they can be approached only through the microscope; and Harvey was dead before Hooke, Malpighi, Swammerdam, or Leeuwenhoek, the fathers of microscopy, began their work. He saw the circulation in shrimps "*ope perspicillo*" indeed—but the perspicillum was a mere handglass. Hence it is not wonderful that Harvey's theory of fecundation is altogether erroneous: and that he is no less mistaken respecting the nature of the parts of the embryo which first make their appearance and the mode of their formation.

Nevertheless, just as it is the fate of dulness to be blind to the significance of justly observed facts, so is it the rare privilege of men of the highest genius to discern the true light among the *ignes fatui* of error. They know the truth, as Falstaff discerned the true prince among his pot companions, by instinct. Explain the matter how we will, it is an indubitable fact that though Harvey's fundamental observations were either inadequate or erroneous, some of his most important general conclusions express the outcome of modern research.

For a whole century Harvey's successors, even though the illustrious Haller was among them, went wrong when Harvey was right; and though Caspar Wolff returned to Harvey's views and thereby laid the foundation of modern embryology, the definitive triumph of the doctrine of epigenesis is the result of labours which have been effected within the memory of living men.

Such appear to me to be the chief claims of Harvey to be held in everlasting honour among men of science. We know that they represent a mere fraction of what he did. But the violence of an unhappy time has robbed us of the rest. I should trespass unwarrantably on your time if I insisted on the applications of Harvey's discoveries to medicine and surgery in the presence of those whose daily avocations bear witness to them.

I have hitherto dwelt upon the claims to our honour of Harvey the philosopher; one word, in conclusion, concerning Harvey the man. There have been great men whose personality one would gladly forget: brilliant capacities besmirched with the stains of inordinate ambition, or vanity, or avarice; or soiled by worse vices; or men of one idea, unable to look beyond the circle of their own pursuits. But no such flaw as any of these defaces the fair fame of William Harvey. The most that tradition has to say against him is, that he was quick of temper and could say a sharp thing on occasion. I do not feel disposed to cast a stone against him on that ground; but rather, such being the case, to marvel at the astonishing, not only self-control, but sweetness, displayed in his two short controversial writings—the letters to Riolan; a man who really was nothing better than a tympanitic philistine, and who would have been all the better for a few sharp incisions.

Moreover, in such a temperament, while the love of appreciation is keen, the sense of wrong at unjust and wilful opposition is no less strong. But I do not recollect, in all Harvey's writings, an allusion to the magnitude of his own achievements or an angry word against his assailants.

Ready to welcome honour if it came, but quite able to be content without it; caring little for anything but liberty to follow in peace his search into the ways of the unfathomable cause of things—"sive Deus, sive Natura Naturans, sive Anima Mundi appelletur?"—one fancies this man of the true Stoic stamp would have summed up his eighty years of good and evil in the line of the poet, which was the favourite aphorism of his great contemporary, Descartes—

"Bene qui latuit bene vixit."

But he lived too well that the memory of his life should be allowed to fall into oblivion; and we may hope that recurring centennial anniversaries will find our successors still mindful of the root from whence their ever-widening knowledge has sprung.

After this Mr. Lowe replied in his usual racy style to the toast of the Universities, naturally having a little fling at the aspirations of Owens College and other recent institutions. Mr. Lowe remarked that anything like competition among the persons who conferred degrees and honours must be productive of evil. The result of such a system had been a kind of Dutch auction of degrees and honours, there being in some quarters a desire to secure as many students as possible by lowering the standard of qualification; but he was happy to think that that evil was about to be remedied, and that they were approaching a time when they would obtain what not only the medical profession, but every individual in this country had a right to demand, namely, that no one should be allowed to heave the lead into the depths of his fellow creature's physical constitution without possessing a certain proved degree of skill. That had been the dream of all sound medical reformers for a long time. It had hitherto remained only a dream, but as he had indicated, it was about to be realised, and he was bound to say that, as far as he understood the question, it was about to be so mainly through the noble and disinterested conduct of the universities, who, instead of displaying selfishness, had expressed their readiness to surrender the privilege they now enjoyed of admitting persons to the medical profession, and to hand over this duty to a certain body possessing the power of fixing a standard of qualification below which no person whatever should be admitted to practise.

Mr. Gladstone, in responding to the toast of "General Science and Literature," said—Great as had been their profession in former times, every one must feel that it was growing greater, wider, more solid from year to year and from generation to generation. He did not speak now of

* "Exercitationes de Generatione," Ex. 50.

literary culture; for although he felt that literature had stood in a very important relation to the medical profession of late years, still literature was necessarily fluctuating, and had been so in all periods of the world. They had gone through a great literary age, as other races had done before, and they could hardly expect the succeeding generation to maintain the same literary level. But as regarded science the case was very different. Nothing here seemed to be required but that patient labour which it was in the power of all men to bestow, together with those large opportunities for observation which we all enjoyed in some degree if we would but use them, and which medical men perhaps enjoyed in a greater degree than any other class of men. As society was developed, as civilisation became more elaborate, as the wants of men, as the enjoyments of men, and as, perhaps, also the dangers of men multiplied, and as the connection of body and mind, which was daily under their eyes, became revealed, they would find their way more and more into the very innermost chambers, so to speak, of human nature. As science progressed their responsibilities would increase, but he was sure they would never be wanting in that capacity and zeal which had ever distinguished them, and that in proportion as their influence over human welfare and human happiness increased, they would obtain that respect and gratitude which, amid their imperfections, mankind were ever ready to extend to their benefactors.

OUR ASTRONOMICAL COLUMN

THE TRANSIT OF MERCURY.—Unfavourable weather appears to have very generally interfered with observations of the first contacts in the transit of May 6, in this country, and in France a similar adverse state of atmospheric conditions also prevailed. At Antwerp, Christiania, Göttingen, Josephstadt (Vienna), Kiel, and San Fernando (Cadiz), the contacts were observed and the results have been mostly published in the *Astronomische Nachrichten*. In two cases only is there any distinction made between what has been called geometrical contact, when Mercury appears perfectly round and his outer limb in coincidence with the sun's limb, and the instant when a fine filament of light is perceptible (or a connecting ligament is broken) which more correctly distinguishes the true internal contact. Thus at Kiel the time was noted when the planet appeared round and when the narrow luminous thread (*deutlicher Lichtfaden*) appeared. But the most complete observations of the first contacts hitherto printed are those made at the Observatory of San Fernando, near Cadiz, which are detailed in a circular issued on May 8, by Señor Cecilio Pujazon, the director of the establishment. Amongst the observers were Señores Garrido and La Flor, who had also experience in the case of the transit in November, 1868, at the same observatory, and with the same or very similar instruments, achromatics by Troughton and Simms of 80 mm. aperture. Three of the observers distinguish between what is termed "first internal contact" and separation of the limbs (*desprendimiento de los limbos*), the mean interval noted between the two phases being 18 seconds.

At Palermo the contacts were noted both with the spectroscope and on the ordinary telescopic method. Prof. Tacchini communicated the particulars to the Paris Academy of Sciences on May 20, at the same time stating that he had been informed of the ill-success attending the observation of the transit at Naples, Florence, Venice, Gallarate (Baron Dembowski's observatory), Genoa, and Modena, on account of unfavourable skies.

In the United States the phenomenon appears to have excited a very unusual degree of interest, occasioned, no doubt, by the instructions for observing it widely circulated by the authorities of the Naval Observatory,